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General Certificate of Education Advanced Subsidiary Examination January 2011

Mathematics

MPC2

Unit Pure Core 2

Monday 10 January 2011 9.00 am to 10.30 am

For this paper you must have:

• the blue AQA booklet of formulae and statistical tables. You may use a graphics calculator.

Time allowed

• 1 hour 30 minutes

Instructions

- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer all questions.
- Write the question part reference (eg (a), (b)(i) etc) in the left-hand margin.
- You must answer the questions in the spaces provided. Do not write outside the box around each page.
- Show all necessary working; otherwise marks for method may be lost
- Do all rough work in this book. Cross through any work that you do not want to be marked.

Information

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 75.

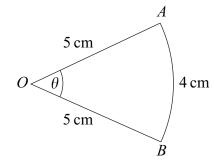
Advice

 Unless stated otherwise, you may quote formulae, without proof, from the booklet.

For Examiner's Use					
Examine	r's Initials				
Question	Mark				
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Answer all questions in the spaces provided.

1 The diagram shows a sector *OAB* of a circle with centre *O* and radius 5 cm.



The angle between the radii OA and OB is θ radians.

The length of the arc AB is 4 cm.

(a) Find the value of θ . (2 marks)

(b) Find the area of the sector OAB. (2 marks)

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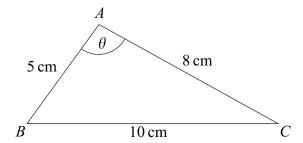
2 (a)	Write down the values of p , q and r given that:
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- (i) $8 = 2^p$; (1 mark)
- (ii) $\frac{1}{8} = 2^q$;
- (iii) $\sqrt{2} = 2^r$. (1 mark)
- **(b)** Find the value of x for which $\sqrt{2} \times 2^x = \frac{1}{8}$. (2 marks)

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The triangle ABC, shown in the diagram, is such that AB = 5 cm, AC = 8 cm, BC = 10 cm and angle $BAC = \theta$.



- (a) Show that $\theta = 97.9^{\circ}$, correct to the nearest 0.1° . (3 marks)
- (b) (i) Calculate the area of triangle ABC, giving your answer, in cm^2 , to three significant figures. (2 marks)
 - (ii) The line through A, perpendicular to BC, meets BC at the point D. Calculate the length of AD, giving your answer, in cm, to three significant figures. (3 marks)

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4 (a)	Use the trapezium rule with four ordinates (three strips) to find an approximate value
	for $\int_0^{1.5} \sqrt{27x^3 + 4} dx$, giving your answer to three significant figures. (4 marks)

(b)	The curve with equation $y = \sqrt{27x^3 + 4}$ is stretched parallel to the x-axis with	ı scale
	factor 3 to give the curve with equation $y = g(x)$. Write down an expression	
	for $g(x)$.	marks

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- Using the binomial expansion, or otherwise, express $(1-x)^3$ in ascending powers of x. (2 marks)
 - **(b)** Show that the expansion of

$$(1+y)^4 - (1-y)^3$$

is

$$7y + py^2 + qy^3 + y^4$$

where p and q are constants to be found.

(4 marks)

(c) Hence find $\int \left[\left(1 + \sqrt{x} \right)^4 - \left(1 - \sqrt{x} \right)^3 \right] dx$, expressing each coefficient in its simplest form. (4 marks)

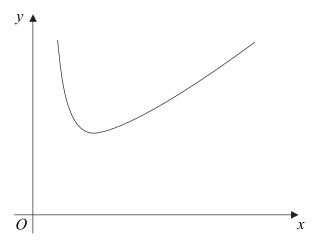
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6		A geometric series has third term 36 and sixth term 972.	
(a) (i)	Show that the common ratio of the series is 3.	(2 marks)
	(ii)	Find the first term of the series.	(2 marks)
(b)	The n th term of the series is u_n .	
	(i)	Show that $\sum_{n=1}^{20} u_n = 2(3^{20} - 1)$.	(2 marks)
	(ii)	Find the least value of n such that $u_n > 4 \times 10^{15}$.	(3 marks)
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A curve C is defined for x > 0 by the equation $y = x + 3 + \frac{8}{x^4}$ and is sketched below.



- (a) Given that $y = x + 3 + \frac{8}{x^4}$, find $\frac{dy}{dx}$. (3 marks)
- (b) Find an equation of the tangent at the point on the curve C where x = 1. (3 marks)
- (c) The curve C has a minimum point M. Find the coordinates of M. (4 marks)
- (d) (i) Find $\int \left(x+3+\frac{8}{x^4}\right) dx$. (3 marks)
 - (ii) Hence find the area of the region bounded by the curve C, the x-axis and the lines x = 1 and x = 2. (2 marks)
- (e) The curve C is translated by $\begin{bmatrix} 0 \\ k \end{bmatrix}$ to give the curve y = f(x). Given that the x-axis is a tangent to the curve y = f(x), state the value of the constant k. (1 mark)

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- 6 (a) Given that $2 \log_k x \log_k 5 = 1$, express k in terms of x. Give your answer in a form not involving logarithms. (4 marks)
 - (b) Given that $\log_a y = \frac{3}{2}$ and that $\log_4 a = b + 2$, show that $y = 2^p$, where p is an expression in terms of b. (3 marks)

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Do not write outside the box

- Solve the equation $\tan x = -3$ in the interval $0^{\circ} \le x \le 360^{\circ}$, giving your answers to the nearest degree. (3 marks)
 - (b) (i) Given that

$$7\sin^2\theta + \sin\theta\cos\theta = 6$$

show that

$$\tan^2\theta + \tan\theta - 6 = 0 (3 marks)$$

(ii) Hence solve the equation $7\sin^2\theta + \sin\theta\cos\theta = 6$ in the interval $0^{\circ} \le \theta \le 360^{\circ}$, giving your answers to the nearest degree. (4 marks)

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